

**REMARKS/ARGUMENTS**

The Applicants have carefully considered this application in connection with the Examiner's Action and respectfully request reconsideration of this application in view of the following remarks.

The Applicants originally submitted Claims 1-25 in the application. In response to a previous Election Requirement, the Applicants withdrew Claims 22-25. Presently, the Applicants have neither amended, canceled nor added any claims. Accordingly, Claims 1-21 are currently pending in the application.

**I. Rejection of Claims 1-4 and 8-10 under 35 U.S.C. §103**

The Examiner has again rejected Claims 1-4 and 8-10 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,162,583 to Yang, *et al.* ("Yang") in view of U.S. Patent No. 6,713,310 to Song, *et al.* ("Song") and further in view of U.S. Patent No. 5,897,713 to Tomioka, *et al.* ("Tom"). Independent Claims 1 and 11 currently include the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. Each of Yang, Song and Tom fails to teach or suggest this same claimed element. Moreover, Yang, Song and Tom may not be properly combined.

Yang is directed to a method for making intermetal dielectrics (IMD) on semiconductor integrated circuits using low dielectric constant spin-on-polymers. (Title) Yang teaches that an IMD2 **18** may be used as a stop layer to form a via hole **2** to a metal line **14**. Yang further teaches that the etch used to form the via hole **2** may include one or more of the following gases: oxygen ( $O_2$ ), trifluoro-methane ( $CHF_3$ ), carbon tetrafluoride ( $CF_4$ ), and carbon dioxide ( $CO_2$ ), and using a carrier gas such as argon (Ar). However, as the Examiner correctly points out, Yang fails to teach or suggest that its IMD2 **18** comprises an aluminum oxide etch stop layer, as well as that the etchant used to etch the IMD3 **20** located over the IMD2 **18** uses a flow rate of carbon oxide greater than about 80 sccm and is selective to the aluminum oxide etch stop layer.

The Examiner, nonetheless, brings in Song for the teaching or suggestion that the IMD2 **18** of Yang may comprise an aluminum oxide etch stop layer, and further brings in Tom for the teaching or suggestion that the etchant uses a flow rate of carbon oxide greater than about 80 sccm and is selective to the aluminum oxide etch stop layer. However, the Examiner is using hindsight to combine Yang with Song and Tom, to arrive at the presently claimed invention. As the Examiner must be aware, motivation based upon hindsight is improper. Thus, the combination of Yang, Song and Tom is improper.

Without even addressing whether Song does teach or suggest the aluminum oxide etch stop layer, and further whether Tom does teach or suggest the claimed flow rate of the carbon oxide, the combination of Yang with Song and/or Tom is improper. Namely, there is no motivation in any of the references to combine their teachings as a whole, and not individually as the Examiner so attempts to do. The Examiner has attempted to provide motivation, albeit improper, for combining the aluminum oxide etch stop layer of Song into the structure of Yang. The Examiner has also attempted to provide motivation, albeit improper, for combining the carbon oxide flow rate of Tom into the manufacturing process of Yang. However, the Examiner has failed to provide any motivation, actual or implied, that it would be obvious to combine the aluminum oxide etch stop layer of Song and the carbon oxide flow rate of Tom together into the structure and manufacturing process of Yang. Without motivation to combine the elements as a whole, the Examiner's motivation argument must fail.

There is clearly no motivation in the references to combine their teachings as a whole. The Applicants' application, in paragraph [0030] thereof, acknowledges the uniqueness of the aluminum oxide etch stop layer, in conjunction with the etchant that uses a flow rate of carbon oxide greater than about 80 sccm (e.g., the etch selectivity to the aluminum oxide etch stop layer). Paragraph [0030] recites in part:

The etchant recipe used to etch the openings 410, 420, is substantially different from conventional etchant recipes. For example, the etchant recipe used to etch the openings 410, 420, comprises a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm, and exemplary greater than about 125 sccm. This specific flow rate, in combination with other tailored factors, allows the etchant to stop on the aluminum oxide etch stop layer 230 without over etching into the microelectronic device 220.

However, none of the references acknowledge the benefits of using the aluminum oxide etch stop layer as an etch stop layer, in conjunction with the acknowledgement of the benefits of using an etchant that uses a flow rate of carbon oxide greater than about 80 sccm (e.g., the etch selectivity to the aluminum oxide etch stop layer). Note that the Examiner concedes, at page 10 of the Examiner's Action dated March 6, 2006, that the references do not acknowledge such a benefit of the combination. Without this recognition, which would take substantial experimentation (or another similar recognition, which would presumably also take substantial experimentation), one skilled in the art would not make such a combination. Thus, combining the aluminum oxide etch stop layer of Song with the structure of Yang, in addition to combining the carbon oxide flow rate of Tom with the combination of Yang and Song, without more than what the Examiner has presented in the way of motivation, would be nothing more than using the presently claimed invention as a blueprint to reconstruct the elements thereof. The Examiner cannot do this. Thus, for this reason alone, the combination is improper.

Moreover, not only do the Applicants argue that the combination as a whole is improper, for the foregoing reasons, but there is also no motivation to combine the individual element of the aluminum oxide etch stop layer of Song into the structure of Yang, or alternatively to combine the individual element of the carbon oxide flow rate of Tom into the structure of Yang. These individual combinations are also improper, and thus will now be addressed.

### **Combination of Yang and Song**

The Examiner's motivation argument (e.g., presented at page 10 of the Examiner's Action dated March 6, 2006) is difficult to understand. However, it appears that the Examiner argues that the motivation to combine Yang with Song exists in Song wherein it teaches that:

"For example, if the interlayer insulation layer **70** and the upper interlayer insulating layer are made of an oxide layer, the patterned via etch-stop layer **80a** is preferably made of a titanium oxide layer, an aluminum oxide layer, a silicon nitride layer, a silicon oxynitride layer, or combinations thereof."

(See, Song at column 4, lines 20-25). It appears that the Examiner is arguing that Song recites that its etch stop layer **80a** may be made of a list of different materials, the list including an aluminum oxide layer and a silicon nitride layer, and in doing so Song draws a similarity between silicon nitride etch stop layers and aluminum oxide etch stop layers. The Examiner attempts to then argue that because Song draws a similarity between a silicon nitride etch stop layer and an aluminum oxide etch stop layer, and further because Yang discloses that its etch stop layer (IMD2 **18**) should comprise silicon nitride, that it would be obvious to exchange the silicon nitride etch stop layer (IMD2 **18**) of Yang with the aluminum oxide etch stop layer of Song.

The Examiner is incorrect as to the motivation to combine Yang and Song, individually, for a number of reasons. First, a list of materials in a patent application does not, alone, indicate that the materials in the list may be arbitrarily exchanged for one another. Additional information or discussion regarding the list would be required to draw such a conclusion that the materials may be arbitrarily exchanged. No such additional information or discussion exists in Song. Second, Yang, or so it appears, is directed specifically to silicon nitride ( $\text{Si}_3\text{N}_4$ ) etch stop layer (IMD2 **18**). Yang teaches or suggests no other materials that the etch stop layer (IMD2 **18**) might comprise. Because Yang devotes so much attention to the silicon nitride ( $\text{Si}_3\text{N}_4$ ) etch stop layer (IMD2 **18**), without even presenting any further examples, one skilled in the art would not be motivated to exchange the silicon nitride ( $\text{Si}_3\text{N}_4$ ) for any other material, and particularly not for the aluminum oxide of Song, as the Examiner suggests. (See, Yang at column 5, lines 55-65). Accordingly, for these and other reasons, no motivation exists for even combining just Yang and Song.

### **Combination of Yang and Tom**

The Examiner's motivation for combining Yang and Tom is equally deficient. The Examiner basis his/her motivation argument with regard to Yang and Tom solely upon the statement that "[t]om discloses that it is conventional in the art to use an etchant that uses a flow rate of CO greater than 80 sccm." (See, page 10 of the Examiner's Action dated March 6, 2006). First, no such "conventional in the art" statement may be found in Tom at or proximate the discussion of the CO flow rate. The paragraph reciting the CO flow rate only recites: A gas mixture of  $\text{C}_4\text{F}_8$  (flow rate: 10 sccm) and CO (flow rate: 200 sccm) is used as the etching gas, and the gas pressure is set to 10 mTorr. (See, Tom at paragraph 16, lines 25-30). This clearly does not indicate that the CO flow rate

is conventional.

Second, Tom teaches the use of CO and Yang teaches only that CO<sub>2</sub> might be used. Nothing in Yang or Tom indicates that the two gasses are substantially similar, or that a flow rate of one (e.g., the 200 sccm flow rate of the CO in Tom) would translate to the other. Accordingly, for these and other reasons, no motivation exists for even combining just Yang and Tom.

Thus, each of Yang, Song and Tom fails to teach or suggest the invention recited in independent Claims 1 and 11 and their dependent claims, when considered as a whole. Moreover, the combination of Yang with Song and/or Tom is improper for the reasons stated above. Accordingly, the cited references fail to establish a prima facie case of obviousness with respect to these claims. Claims 1-4 and 8-10 are therefore not obvious in view of the combination.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 1-4 and 8-10 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

## **II. Rejection of Claims 11-14 and 18-21 under 35 U.S.C. §102**

The Examiner has rejected Claims 11-14 and 18-21 under 35 U.S.C. §103(a) as being unpatentable over Yang in view of Song, and further in view of Tom. As previously indicated, independent Claims 1 and 11 currently include the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. As previously established, each of Yang, Song and Tom fails to teach or suggest the invention recited in independent Claims 1 and 11 and their

dependent claims, when considered as a whole. Moreover, as also previously established, the combination of Yang with Song and/or Tom is improper for the reasons stated above. Accordingly, the cited references fail to establish a *prima facie* case of obviousness with respect to these claims. Claims 11-14 and 18-21 are therefore not obvious in view of the combination.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 11-14 and 18-21 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

### **III. Rejection of Claim 7 under 35 U.S.C. §102**

The Examiner has rejected Claim 7 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,324,683 to Fitch, *et al.* ("Fitch") in view of Song, and further in view of Tom. As previously indicated, independent Claims 1 and 11 currently include the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. However, as the Examiner correctly points out, Fitch also fails to teach or suggest that its etch stop layer comprises an aluminum oxide etch stop layer, as well as that the etchant used to etch the substrate located over the etch stop layer uses a flow rate of carbon oxide greater than about 80 sccm and is selective to the aluminum oxide etch stop layer. Moreover, for the same reasons that the combination of Yang, Song and Tom is improper, the combination of Fitch, Song and Tom is improper.

Therefore, each of Fitch, Song and Tom fails to teach or suggest the invention recited in independent Claims 1 and 11 and their dependent claims, when considered as a whole. Moreover,

the combination of Fitch with Song and/or Tom is improper for the reasons stated above. Accordingly, the cited references fail to establish a prima facie case of obviousness with respect to this claim. Claim 17 is therefore not obvious in view of the combination.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claim 17 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

#### **IV. Rejection of Claim 17 under 35 U.S.C. §102**

The Examiner has rejected Claim 17 under 35 U.S.C. §103(a) as being unpatentable over Fitch in view of Song, and further in view of Tom. As previously indicated, independent Claims 1 and 11 currently include the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. As previously established, each of Fitch, Song and Tom fails to teach or suggest the invention recited in independent Claims 1 and 11 and their dependent claims, when considered as a whole. Moreover, as also previously established, the combination of Fitch with Song and/or Tom is improper for the reasons stated above. Accordingly, the cited references fail to establish a prima facie case of obviousness with respect to this claim. Claim 17 is therefore not obvious in view of the combination.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claim 17 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

**V. Rejection of Claims 5 and 15 under 35 U.S.C. §102**

The Examiner has rejected Claims 5 and 15 under 35 U.S.C. §103(a) as being unpatentable over Yang in view of Song and Tom, and further in view U.S. Patent Pub. No. 2003/0127422 to Tsuchiya ("Tsu"). As previously indicated, independent Claims 1 and 11 currently include the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. As previously established, each of Yang, Song and Tom fails to teach or suggest the invention recited in independent Claims 1 and 11 and their dependent claims, when considered as a whole. Moreover, as also previously established, the combination of Yang with Song and/or Tom is improper.

Tsu fails to correct the deficiencies of Yang, Song and Tom. Specifically, Tsu fails to teach or suggest the element of etching an opening in the substrate using an etchant comprising a carbon oxide, a fluorocarbon, an etch rate modulator, and an inert carrier gas, wherein a flow rate of the carbon oxide is greater than about 80 sccm and the etchant is selective to the aluminum oxide etch stop layer. Accordingly, the cited references fail to establish a prima facie case of obviousness with respect to these claims. Claims 5 and 15 are therefore not obvious in view of the combination.

In view of the foregoing remarks, the cited references do not support the Examiner's rejection of Claims 5 and 15 under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw the rejection.

## **VI. Allowable Subject Matter**

The Examiner has indicated that Claims 6 and 16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The Applicants appreciate the Examiner's belief that these claims contain allowable subject matter, however, the Applicants are still of the belief that the independent Claims include allowable subject matter without amending them to contain the elements of the dependent claims of which the Examiner has indicated contain allowable subject matter. Nevertheless, while the Applicants choose not to include the allowable subject matter of the dependent Claims into the independent Claims at this time, the Applicants reserve the right to do so in the future if necessary.

## VII. Conclusion

In view of the foregoing remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a Notice of Allowance for Claims 1-21.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application. The Commissioner is hereby authorized to charge any fees, credits or overpayments to Deposit Account 20-0668.

Respectfully submitted,

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Dated: May 5, 2006

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